(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 198 362**
A2

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: 86104634.0

(22) Date of filing: 04.04.86

(51) Int. Cl.⁴: B65D 81/34 , A47J 36/02 , H05B 6/64

(30) Priority: 13.04.85 JP 79039/85
19.10.85 JP 232309/85
14.01.86 JP 4269/86

(43) Date of publication of application:
22.10.86 Bulletin 86/43

(84) Designated Contracting States:
BE CH DE FR GB IT LI NL

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(54) **Food receptacle for electronic oven cooking and cooking method using the same.**

(57) Disclosed are a food receptacle for electronic oven cooking which comprises at least one steam controlling opening for allowing steam to blow off therethrough when an internal pressure in the receptacle is increased beyond a certain value by the steam generated on electronic oven heating, and a method of electronic oven cooking which comprises using the receptacle described above, and adjusting the internal pressure in the receptacle to the range of 1.00 to 1.15 atm and a temperature to the range of 100 to 105°C.

The receptacle is inflatable with an increase of the internal pressure induced by the steam generated therein on the electronic oven heating, whereby the completion of the cooking can be confirmed by visual observation. The receptacle is preferable to be composed of a heat-resistant synthetic resin not permeable to oil and moisture. Further, the receptacle is preferably prepared from a sheet comprising a single layer film or a laminated film of the synthetic resin.

In the cooking method, it is preferable that the steam is allowed to blow off through the opening for a period of 1 to 10 seconds.

EP 0 198 362 A2

FOOD RECEPTACLE FOR ELECTRONIC OVEN COOKING AND COOKING METHOD USING THE SAME

BACKGROUND OF THE INVENTION

(1) Technical Field

The present invention relates to a food receptacle for electronic oven cooking and a method for cooking the food by using the same. More particularly, it relates to a food receptacle for electronic oven cooking which comprises at least one steam controlling opening for adjusting an internal pressure in the receptacle within a particular range and a method for cooking the food by using the same.

(2) Background Information

At present, frozen foods are widely cooked by using electronic ovens. However, the satisfactory result can not be obtained, because the cooked food becomes harder due to excessive time of cooking or, in contrast with this, the food is insufficiently defrozen by too short time of cooking, even if the the electronic oven is set at a time and a teperature indicated on the commercial frozen food.

These disadvantages in electronic oven cooking are considered to be induced by the following causes:

(1) Electronic ovens are largely different from one another in mechanism of electron radiation, in shape of an angular portion and in range thereof.

(2) The temperatures of chilled or cold foods vary from -25°C to +10°C, according to whether the foods have been placed in a large-sized cold storage or a refrigerator car, a place where a freezing chamber is located and a state where the foods are permitted to stand before use. There is an extremely large difference between a dielectric constant of food moisture in glacial state and a dielectric constant of food moisture in aqueous state.

(3) Generally, the frozen foods are also different from one another in moisture content, in oil content and in the other constituents. Particularly, in the glacial state of the food moisture, greatly different electronic oven heating is required.

In addition to the above three causes, the following two causes are cited.

(4) In the conventional cooking, the results are little affected by the difference of 5 to 10 minutes in cooking time. In the electronic oven cooking, however, the results that the cooked food is cold yet, it is too hard because of moisture release, it is too dry, and so on are caused by the difference of 10 to 20 seconds in cooking time.

(5) In the conventional electronic oven cooking, the electronic oven is required to be set at the time indicated on the frozen food as the rough measure. However, it is difficult to cook the frozen food in a state being good for eating for the reasons described above.

The food placing table of the electronic oven can not be uniformly heated. The table includes portions which are increased in temperatures by the electronic oven heating, and portions which do not undergo the electronic oven heating and are therefore not appreciably increased in temperatures. Consequently, different times are required for cooking suitably, depending upon portions of the table where the food is placed. Further, the radiation heating parts are entirely different from one another in shape of the radiation surface and in range, according to types of the electronic ovens. Furthermore, the times for defreezing and cooking vary, according to the kinds of the frozen foods. Furthermore, even in the same kind of foods, appropriate times for defreezing and cooking vary according to amounts of the components contained in the frozen foods, such as moisture and oil. These different conditions cause variations in the results. Accordingly, it has been impossible to expect the cooking results which are always satisfied.

Describing the present situation of the cooked and half-cooked frozen foods, as the conventional frozen foods, there are typically mentioned meat, fishes and shellfishes coated with flour to be ready for frying, humburger steaks and meat balls ready for grilling, and the like. There are also included vegetables such as corn, onion, potato and the like, either sliced or not, after boiled. All these frozen foods are, however, defrozen once and there after fried, grilled or steamed once again, and they can not be eaten directly by defreezing and heating in the electronic oven.

In the case that the already cooked frozen food is defrozen and heated in the electronic oven, if the fried frozen food with flour coating is entirely defrozen, the moisture in the flour coating is evaporated, because dish-like open vessels made of glass or ceramic materials are used.

Consequently, the food becomes harder and has an entirely different feel to mouth. In addition, the oil comes up to the surface of the food and thereby the balance of taste is lost. When the grilled frozen food is defrozen and heated in the electronic oven, the oil melted out of the food similarly gathers to the surface of the food, resulting in stickiness of the surface. Further, the surface of the food becomes harder and crumbly to give a different feel to mouth by heating the food for a longer period of time, although the frozen food can be entirely defrozen. Furthermore, the frozen food which was boiled and sliced can be heated in the electronic oven without hindrance, if the heating is carried out after the food has been defrozen. If the food is heated in the form of the frozen block, the outer portion thereof will be scorched while the inner portion thereof remains frozen. The higher the moisture content in the food is, in other word, the more the moisture frozen portions are contained in the food, the more this trend is pronounced. These are due to a significant difference between the dielectric constants of frozen parts and aqueous parts. This difference in dielectric constant is caused by quick loss of the moisture in the outer portion of the food, when the food is heated in the electric oven, that is to say, by lack of moisture evaporation balance between the outer portion and the inner portion of the food. This is responsible for deterioration of the food quality. Because of these drawbacks, the cooked frozen foods are limited to extremely few kinds. Niku-mans (meat buns), an-mans (bean-jum buns), shao-mais and gyozas have been naturally defrozen or rendered into a chilled state in a refrigerator from the frozen state, and thereafter the electronic oven has been used only for heating them. The frozen foods have seldom been directly treated in the electronic oven. Usually the frozen shao-mais are heated in the electronic oven after placing the frozen shao-mais on a dish, adding a predetermined amount of water thereto and covering the shao-mais with a wrapping film. In this method, the functions of the electronic oven are not sufficiently utilized. At present, the electronic oven is utilized only for minor purposes such as heating of sake, milk, wet towels and the like or difreezing of frozen cuttlefishes and prawns. The electronic oven has originally been provided for the purpose of cooking the already-cooked, namely fried or grilled, frozen food such as fried meat, fishes and shellfishes with flour coating and grilled humburger steaks. There are currently not present, however, the already-cooked frozen foods packed in receptacles for the electronic oven heating. The frozen foods presently available at shops are packed in ordinary paper dishes or paper boxes. The foods available for the electronic oven heating are sold in the chilled state because the frozen foods have the drawbacks noted hereinbefore. The foods which have been transported under the frozen state are once converted to the chilled foods before heating in the electronic oven. This is not a procedure in which the foods are directly restrored from the frozen state, and therefore the original purpose of the electronic oven is not fullfilled. Moreover, the heating of the foods in the electronic oven is usually carried out in vessels made of glass or ceramic materials. In this case, oil and moisture melted out of the fried or grilled foods containing oil, such as chicken nuggets and humgurger steaks, adhere to the finger when the foods are taken out of the vessels, or to the vessels and the oven body. It is very time-consuming to wash the fingers, the vessels and the oven body contaminated with oil and moisture. To overcome these defects, paper or the paper vessel is usually used as the oil remover. These problems, however, are not yet solved.

Thus, the electronic oven can not be utilized for the original purpose by the reasons described above.

Particularly, measures of cooking times of the electronic oven can not be known and the difference of 10 to 20 seconds in cooking time causes the extreme change in feel to mouth and taste of the resulting food. These are the main reasons that the electronic oven, which should be highly convenient, has not been utilized for cooking the various foods and the diffusion of genuine cooked cold foods has been hinderd.

SUMMARY OF THE INVENTION

It is therefore a primary object of the present invention to provide a food receptacle for electronic oven cooking which makes it possible to cook the food suitably according to a kind thereof, regardless of the differences in types of the electronic ovens and in kinds of the frozen foods described above, when the frozen food is cooked in the electronic oven.

It is a further object of the present invention to provide a method for cooking the food by using the receptacle described above.

For the purpose of achieving the above-mentioned objects, the present inventors have variously studied food receptacles for electronic oven cooking.

As a result, it has been found that the problems described above are solved by using a receptacle having at least one steam controlling opening for allowing steam to blow off therethrough when an internal pressure is increased on electronic oven heating of the food, thus arriving at the present invention.

In accordance with the present invention, there are provided a food receptacle for electronic oven cooking which comprises at least one steam controlling opening for allowing steam to blow off therethrough when an internal pressure in the receptacle is increased beyond a certain value by the steam generated on electronic oven heating of the food; a food receptacle for electronic oven cooking which comprising at least one steam controlling opening formed in such a manner that an internal pressure in the receptacle is adjustable to the range of 1.00 to 1.15 atm and a temperature in the receptacle is adjustable to the range of 100 to 105°C, on the electronic oven heating of the food; a food receptacle for electronic oven cooking which is inflatable with the increase of the internal pressure induced by the steam generated therein on the electronic oven heating of the food, and comprises at least one steam controlling opening for allowing steam to blow off therethrough when the internal pressure is increased beyond a certain value by the steam generated on the electronic oven heating of the food; a method of electronic oven cooking which comprises using the food receptacle for electronic oven cooking, said receptacle having at least one steam controlling opening for allowing steam to blow off therethrough when the internal pressure in the receptacle is increased beyond a certain value by the steam generated on the electronic oven heating of the food, and adjusting the internal pressure in said receptacle to the range of 1.00 to 1.15 atm and the temperature in said receptacle to the range of 100 to 105°C, thereby cooking the food for electronic oven cooking; and a method of electronic oven cooking which comprises using the food receptacle for electronic oven cooking, said receptacle being inflatable with the increase of the internal pressure induced by the steam generated therein on the electronic oven heating of the food and having at least one steam controlling opening for allowing the steam to blow off therethrough when the internal pressure in said receptacle is increased beyond a certain value by the steam generated on the electronic oven heating of the food, and allowing the steam to blow off through the steam controlling opening for a period of 1 to 10 seconds, thereby cooking the food for electronic oven cooking.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1(a) is a schematic perspective view showing a bag-shaped food receptacle for electronic oven cooking of the present invention before cooked;

FIG. 1(b) is a schematic side view showing a bag-shaped food receptacle for electronic oven cooking of the present invention after cooked;

FIG. 2(a) is a schematic perspective view showing a cup-shaped food receptacle for electronic oven cooking of the present invention before cooked;

FIG. 2(b) ia a schematic side view showing a cup-shaped food receptacle for electronic oven cooking of the present invention after cooked;

FIG. 3(a) s a schematic sectional view showing a lid of a cup-shaped food receptacle of the present invention;

FIG. 3(b) is a schematic perspective view, partly in section showing a double cup-shaped food receptacle of the present invention;

FIG. 4(a) is a schematic perspective view showing a tray-shaped food receptacle for electronic oven cooking of the present invention before cooked;

FIG. 4(b) is a schematic side view showing a tray-shaped food receptacle for electronic oven cooking of the present invention after cooked;

FIG. 5(a) is a schematic side view showing a bag-shaped food receptacle for electronic oven cooking of the present invention before cooked, which contains a tray;

FIG. 5(b) is a schematic side view showing a bag-shaped food receptacle for electronic oven cooking of the present invention after cooked, which contains a tray;

FIG. 5(c) is a schematic sectional side view, showing a bag-shaped food receptacle for electronic oven cooking of the present invention which contains a tray provided with moisture-and oil-absorptive paper on the bottom thereof;

FIG. 6(a) is a schematic side view, partly in section showing a bag-shaped food receptacle for electronic oven cooking of the present invention before cooked, which is placed in a cup;

FIG. 6(b) is a schematic side view, partly in section showing a bag-shaped food receptacle for electronic oven cooking of the present invention after cooked, which is placed in a cup;

FIG. 7 is a schematic sectional view showing a

sheet or film of a single layer of a synthetic resin which is used for a receptacle of the present invention;

FIGS. 8 to 10 are schematic sectional views each showing a laminated sheet or film of a synthetic resin which is used for a receptacle of the present invention;

FIG. 11 is a schematic sectional view showing a tray-shaped food receptacle of the present invention;

FIGS. 12 and 13 are schematic perspective views each showing a tray-shaped food receptacle of the present invention; and

FIG. 14 is a schematic perspective view showing a bag-shaped food receptacle of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The food receptacle according to the present invention may have any shape such as a bag, a cup and a tray, so long as it can contain the food and can be sealed.

In the present invention, it is important that the receptacle has at least one steam controlling opening for allowing steam to blow off therethrough when the internal pressure in the receptacle is increased by the steam generated on electronic oven heating of the food packed with the receptacle.

The internal pressure in the receptacle is preferable to be in the range of 1.00 to 1.15 atm. The temperature in the receptacle is preferable to be in the range of 100 to 105°C

If the frozen food is cooked in the electronic oven at an internal pressure of less than 1.00 atm for a shorter period of time, undefrozen parts sometimes remain in the cooked food because of the difference in dielectric constant of glacial parts.

On the other hand, if an internal pressure of at least 1.15 atm and a temperature of at least 105°C are applied, the perforated portion or sealed portion of the receptacle are sometimes broken to form an open state. It is therefore necessary to use a very high pressure-resistant and heat-resistant material for the receptacle. This causes an increase in material cost from the economic standpoint.

When the receptacle which is inflatable with the increase of the internal pressure and can maintain the internal pressure constant by moisture evaporation balance is used, the degree of inflation of the receptacle can be adopted as a measure showing the completion of cooking of the food contained in the receptaice.

The microwaves emitted from the electronic oven are absorbed in the food and vibrate the molecules in the food to generate frictional heat. The frozen food is heated for defreezing by the frictional heat thus generated. This procedure can be carried out in an atmosphere of uniform steam pressure by adjusting the steam pressure in the receptacle on the electronic oven heating. On the other hand, when the frozen food is heated for defreezing in an open atmosphere in which an internal pressure of steam is not produced, the electronic oven heating of the food is carried out after defreezing the frozen food on natural standing. The overall time of the procedure, however, is from 10 to 20 times that of the present invention. Moreover, in the conventional method, the food is heated for defreezing at 100W successively, and thereafter heated at 500W. The time required for it is from 3 to 4 times that of the present invention. Furthermore, the resulting cooked food according to the conventional method is extremely inferior in feel to mouth and taste, and can not be accepted as a satisfactory cooked food. According to the present invention, the frozen food can be satisfactorily cooked for a shorter period of time, and especially the time reduction effect is remarkable in case that the frozen food in glacial state which has an extremely low dielectric constant is defrozen. Further, the selection of the steam pressure makes it possible to maintain taste of the food constant.

The steam controlling opening for adjusting the steam pressure in the receptacle may be formed at any position of the receptacle. The size, shape and number of the steam controlling opening can approximately be determined by the calculation from the size or the volume of the receptacle and the kind of the food to be cooked or moisture content included in the food, particularly from the amount of glacial parts having an extremely low dielectric constant. Although the fine adjustment is required, of cause, for each food according to the constituents of the food such as hydrocarbons, proteins, ashes and oils, the bag receptacle which is usually 80mm by 180mm in dimensions and 300cc in total volume, except the lace portion, has 3 to 6 openings each being from 0.5 to 2mm in diameter.

Also in the case of the cup or tray receptacle being 300cc in inner volume, 3 to 6 openings having a diameter of 0.5 to 2mm are formed similarly to the bag receptacle.

The shape of the steam controlling opening is usually circular. The receptacle, however, may be provided with X-shaped or V-shaped cut which forms the opening by being pushed up with the aid of ejected steam.

The single bag is perforated after bag making by means of metal needles or heated metal needles movable up and down. In the case of the mass production, the bag is perforated by means of the above-mentioned needles in the crank movement, when the bags are automatically prepared and the food is packed therein in a continuous process.

The steam controlling opening may be covered with a seal or a wrapper, whereby the frozen food can be prevented from the moisture evaporation while being in the frozen state, as well as it can be maintained under good sanitary conditions. When it is cooked in the electronic oven, the seal or the wrapper are removed to actuate the steam controlling opening. Instead of the opening, a control valve for adjusting the internal pressure in the receptacle may be provided. Because the steam controlling opening can be covered with the seal or the wrapper, for example, a salt or pH stabilizer can be added to the food packed in the receptacle as generally practiced, or the packed food can be sterilized by heating it in the electronic oven as partly practiced, through the steam controlling opening, for storage or transfer. This receptacle can be utilized for packing the food sterilized for long-period storage by a high-pressure or low-pressure retort sterilizing process in the sterilized receptacle. The receptacle may be composed of a retort-resistant material and the steam controlling opening can be formed after the retort sterilizing treatment.

It is apparent from all experiments of the cooked foods that the steam controlling opening formed on the receptacle of the present invention result in remarkable reduction in electronic oven heating time. Further, it became apparent from the detailed experiments that the steam amounts generated on the electronic oven heating and the times taken until the steam was generated varied with the temperature and the kind of material of the food packed in the receptacle, and with the size of the steam controlling opening. For all the foods, when steam was allowed to blow off through the steam controlling opening for a period of not more than about 10 seconds, preferably 3 to 8 seconds, the palate, namely the taste, the flavor and the feel to mouth, was best. When the mechanism of the present invention is not applied to the frozen food, a long period of time is required for defreezing and the food satisfactorily cooked can not be obtained. When the steam blowing-off time largely exceeds the time described above, for example, when the time exceeds about 5 seconds for chicken nuggets, the taste and flavor are deteriorated and the feel to mouth becomes harder and too dry.

On the other hand, immediately before blowing off of steam, the packed food is entirely defrozen, but it feels lukewarm and has a different feel to mouth. When the steam blowing-off time exceeds 10 seconds, the taste and flavor are deteriorated as a matter of course and the softness of the meat and the flour coating is lost.

This shows that the electronic oven heating time is extremely short, for example several minutes, compared with the boiling, the grilling, the steaming and the like which have generally been carried out by using charcoal fire, gas fire, electric heat and the like, so that the palate, namely the taste, the flavor and the feel to mouth, is influenced by a time lag of several seconds in a final stage. This is a new information first found by the present inventors. That is to say, it was found that the electronic oven cooking could not be suitably carried out for each food by the conventional rough push button system of the electronic oven, because a time lag allowable for the termination of electronic oven heating is extremely narrow, and that particularly for the foods having the taste, the flavor and the feel to mouth already completed such as the cooked foods, this tendency was pronounced.

The cooking of all the foods is terminated after steam is allowed to blow off for a period of not more than 10 seconds, preferably for a period of 3 to 8 seconds. Therefore, the steam blowing-off time can be taken as a measure of the termination of the cooking, and anyone can satisfactorily cook various foods by the electronic oven with ease.

To terminate the electronic oven heating after steam is allowed to blow off for a period of not more than 10 seconds, preferably for a period of 3 to 8 seconds, there can be applied a method in which the degree of the inflation of the receptacle is confirmed by the visual observation, a method in which the steam blowing-off time is perceived by a moisture sensor mounted in the electronic oven, and the electronic oven heating is automatically terminated thereby, and so on.

In cooking, it is sometimes preferable to supply an amount of water released from the food on the electronic oven heating, whereupon more good taste can be maintained by the supply of water.

The receptacle of the present invention is composed of a synthetic resin which has a heat resistance (at least 110°C) and is not permeable to oil and moisture. The synthetic resins includes polyesters such as polyethylene terephthalate, polyamides such as nylon 6 and nylon 66, polyimides, polyamideimides, polypropylene such as drawn or undrawn polypropylene (OPP or CPP), heat-resistant polyethylene such as high density

polyethylene (HD), medium density polyethylene - (MD) and low density polyethylene (LD), mixtures thereof, and the like. Glass and ceramics can also be used for the receptacle.

The synthetic resin can be used in the form of a film or sheet of a single layer as shown in Fig. 7, or a film or sheet of multi layers as shown in Figs. 8 to 10.

When the receptacle is used for the frozen or chilled food, the receptacle is preferably prepared from a particular laminated sheet or film comprising three layers, namely, outer and inner layers of the synthetic resin film described above and an intermediate layer of paper or nonwoven fabric, or a particular laminated sheet or film comprising two layers, namely an outer layer of the synthetic resin film described above and an inner layer of nonwoven fabric.

The receptacle comprising the synthetic resin film sticked on a paper vessel by a hot pressing method and so on can also be used.

One embodiment of the above-mentioned particular laminated sheet is the sheet of three layers, as shown in Figs. 8 and 9, wherein the outer layer 11 or 11' is composed of the heat-resistant synthetic resin film not permeable to oil and moisture, the intermediate layer 10 or 10' is composed of paper or nonwoven fabric having oil and moisture absorptive properties, and the inner layer 12 or 12'is composed of the heat-resistant synthetic resin film having small openings "a" through which oil and moisture released from the food on the heating are allowed to pass outside by the capillary phenomenon. The intermediate layer of paper or nonwoven fabric may be provided with small openings for enhancing the capillary phenomenon described above. Another embodiment of the laminated sheet is the sheet of two layers, as shown in Fig. 10, wherein the outer layer 11" is composed of the heat-resistant synthetic resin film not permeable to oil and moisture, and the inner layer 10' is composed of nonwoven fabric such as a sheet prepared by pressing and heat sticking mixed web of moisture and oil-absorptive fibers and synthetic resin fibers. The receptacle of the present invention can be prepared by these laminated sheets or films, and the electronic oven cooking of the present invention can be carried out by using such a receptacle.

Further, the cup or tray having such a sheet of three layers or two layers with which the bottom thereof is covered can be used as the receptacle of the present invention.

The receptacle of the present invention can be prepared by the single sheet or film and the laminated sheet or film of the heat-resistant synthetic resin described above. Exemplifying the combination of the outer layer-the intermediate layer-the inner layer as the laminated sheets used in the present invention, there are mentioned a polyester-paper or nonwoven

fabric-polyethylene, a polyester-paper or nonwoven fabric-a polyamide, a polyester-paper or nonwoven fabric-a polyimide, a polyester-paper or nonwoven fabric-polypropylene, a polyester-paper or nonwoven fabric-a polyester, a polyamide-paper or nonwoven fabric-polyethylene, a polyamide-paper or nonwoven fabric-a polyester, a polyamide-paper or nonwoven fabric-polypropylene, a polyamide-paper or nonwoven fabric-a polyimide, a polyamide-paper or nonwoven fabric-a polyamide, a polyimide-paper or nonwoven fabric-polyethylene, a polyimide-paper or nonwoven fabric-a polyester, a polyimide-paper or nonwoven fabric-polypropylene, a polyimide-paper or nonwoven fabric-a polyamide, a polyimide-paper or nonwoven fabric-a polyimide, polypropylene-paper or nonwoven fabric-a polyethylene, polypropylene-paper or nonwoven fabric-polyester, polypropylene-paper or nonwoven fabric-a polyamide,

polypropylene-paper or nonwoven fabric-polypropylene, a polyester-nonwoven fabric, polypropylene-nonwoven fabric, a polyamide-nonwoven fabric and the like.

These laminated sheets can be utilized as the whole or a part of the receptacle. For example, in the case of the cup or the tray, the laminated sheets may be used only for the body and another material may be used for the lid. Further, the sheet described above can be used only for the bottom.

The receptacle prepared by the materials described above are inflatable by the steam pressure generated on the electronic oven heating, and the steam is advantageously allowed to blow off through the steam controlling opening of the receptacle. Moreover, oil and moisture released from the food are suitably absorbed in the moisture-and oil-absorptive paper or nonwoven fabric of the intermediate layer (in the case of the laminated sheet of three layers) or in the nonwoven fabric of the inner layer (in the case of the laminated sheet of two layers). Therefore, oil does not come up to the surface of the food, and accordingly the resulting food is not different from the usual cooked foods in both taste and feel to mouth.

The foods utilized in the present invention include the frozen foods and the chilled foods, and particularly the cooked foods which have not been able to be deliciously cooked by the conventional electronic oven heating, for example, the oil containing foods such as chicken nuggets, humburger steaks and pork cutlets, chow mein, frizzled noodle, spaghetti and the like are preferably mentioned. However, the method of the present invention can be applied for steam cooking not only of these foods, but also of uncooked foods such as meat and fishes.

The present invention relates to the food receptacle for electronic oven cooking which comprises a steam controlling opening for allowing steam to blow off therethrough when an internal pressure in the receptacle is increased beyond a certain value by the steam generated on electronic oven heating of the food. The internal pressure in the receptacle can be adjusted to the range of 1.00 to 1.15 atm and the temperature in the receptacle can be adjusted to the range of 100 to 105°C. Further, the receptacle is inflatable by the increased internal pressure. The steam is allowed to blow off through the steam controlling opening for a period of not more than 10 seconds, and thereafter the heating is stopped.

By these feature, the raw foods, as well as the frozen and chilled foods, can be deliciously cooked for a short period of time, without regard to the types of the electronic ovens, the portions in the electronic oven where the food is placed, the kinds of the foods, and the differences in moisture and oil contents of the foods.

Further, the completion of the cooking can be confirmed by observing the inflation of the receptacle, as well as by the blowing-off time of the steam. The cooking operation is therefore extremely simple and easy.

The present invention will now be described in detail with reference to the following examples that by no means limit the scope of the invention.

Example 1

Bag-shaped and box-shaped receptacles were prepared by a laminated sheet of three layers. An inner layer which was in direct contact with food was constituted by a 0.04mm-thick heat-resistant polyethylene (HD) film for food-packing use, which had a heat resistance of 125 to 135°C and openings of 0.01mm diameter arranged at intervals of 1mm in longitudinal and transversal directions. An intermediate layer was constituted by Japanese paper of an amount of 30g/m² and an outer layer was constituted by a 0.05mm-thick polyethylene terephthalate film having a heat resistance of 260°C and being not permeable to moisture and oil. These receptacles were provided with small steam controlling openings which adapted to the amount of moisture evaporated from the sealed frozen food. The number of the openings was 6 and each of openings had a diameter of lmm. In the case of the box-shaped receptacle, the openings were formed in the neighborhood of the top seal portion. The bag-shaped receptacle was 80mm by 180mm in dimensions. Pork cutlets and green soybeans sealed in the bag-shaped receptacle described above were cooked as follows. Both the foods were held frozen at a temperature of -35°C overnight and then heated in an electronic oven. The bag containing the pork cutlets was inflated after the lapse of 90 seconds, and surplus steam was released through the steam controlling openings, whereupon the pressure in the bag was 1.074 atm and the temperature was 102°C. When the heating was stopped after the steam was allowed to blow off through the openings for 2 minutes, the inflated bag immediately returned to its original state. The mixture of oil and moisture rather rich in oil was absorbed in the moisture-and oil-absorptive paper of the intermediate layer by the capillary phenomenon through the small openings formed in the inner layer. The coating of the resulting cutlets was soft. This was due to the oil and moisture content in an equilibrium moisture state inside the bag obtained as a result of control by the steam controlling openings. When the cutlets were taken out immediately after the heating, they had a feel just like they were steamed, but they had no surface glittering by oil. When they were left for 10 minutes, both moisture and oil were absorbed in the coating so that they were stabilized. Their taste and feel to mouth were close to those just after fried. The green soybeans, which were boiled, were uniformly steamed by the equilibrium moisture content in the bag induced by the penetrating function of moisture into the moisture- and oil-absorptive paper through the capillary phenomenon and the function of the steam controlling openings which number was three times that of the openings in the case of the cutlets. This effect was combined with the heating effect of the electronic oven. The bag was inflated after the lapse of 100 seconds, and the steam was simultaneously allowed to blow off through the steam controlling openings for 5 seconds, whereupon the pressure in the bag was 1.074 atm and the temperature was 102°C. The food taken out after heated for a period of 90 seconds did not substantially differ from that restored separately by heating with hot water for a period of 10 minutes. Further, similar results could

be obtained in the cases of chicken nuggets and hamburger steaks without sauce. With respect to the box-shaped receptacle, the same results as those in the case of the bag described above could be obtained. The box-shaped receptacle was particularly suitable for the electronic oven cooking of the already-cooked frozen foods such as chow mein, spaghetti, frizzled noodle, frizzled boiled rice, boiled rice containing green peas and the like.

In the case of the bag, the food contained therein is compressed. The box-shaped receptacle, however, can prevent the food from the compression and the food can be kept soft and full. Therefore, the commercial value of the food is effectively hightened.

Example 2

Bag-shaped and box-shaped receptacles were prepared by a laminated sheet of three layers. An inner layer which was in direct contact with food was constituted by a 0.04mm-thick heat-resistant polyethylene (HD) film for food-packing use, which had a heat resistance of 125 to 135°C and openings of 0.01mm diameter arranged at intervals of 1mm in longitudinal and transversal directions. An intermediate layer was constituted by nonwoven fabric comprising paper and polyethylene of 80g/m² and an outer layer was constituted by a 0.05mm-thick polyethylene terephthalate film having a heat resistance of 260°C and being not permeable to moisture and oil. These receptacles were provided with small steam controlling openings which adapted to the amount of moisture evaporated from the sealed frozen food. The number of the openings was 6 and each of openings had a diameter of 1mm. In the case of the box-shaped receptacle, the openings were formed in the neighborhood of the top seal portion. The bag-shaped receptacle was 80mm by 180mm in dimensions. Pork cutlets and green soybeans sealed in the bag-shaped receptacle described above were cooked as follows. Both the foods were held frozen at a temperature of -35°C overnight and then heated in an electronic oven. The bag containing the pork cutlets was inflated after the lapse of 90 seconds, and surplus steam was released through the steam controlling openings, whereupon the pressure in the bag was 1.074 atm and the temperature was 102°C. When the heating was stopped after the steam was allowed to blow off through the openings for 2 seconds, the inflated bag immediately returned to its original state.

The mixture of oil and moisture rather rich in oil was absorbed in the moisture-and oil-absorptive nonwoven fabric of the intermediate layer by the capillary phenomenon through the small openings formed in the inner layer. The coating of the resulting cutlets was soft. This was due to the oil and moisture content in an equilibrium moisture state inside the bag obtained as a result of control by the steam controlling openings. When the cutlets were taken out immediately after the heating, they had a feel just like they were steamed, but they had no surface glittering by oil. When they were left for 10 minutes, both moisture and oil were absorbed in the coating so that they were stabilized. Their taste and feel to mouth were close to those just after fried. Also with reference to green soybeans, chicken nuggets and hamburger steaks without sauce, almost the same results as those in Example 1 were obtained.

In regard to the box-shaped receptacle, the same excellent results as those in case of the bag described above could be obtained as described in Example 1.

Example 3

A cup-shaped receptacle was prepared by a laminated sheet of three layers which comprises a polyester film, paper and polyethylene film having openings. The receptacle was 250cc in volume and had steam controlling openings of 1.0mm in diameter. Using this receptacle, various cooked foods were cooked by an electronic oven according to the conditions shown in Table 1 described below. On the cooking, 5% of moisture content was supplied to the cooked foods. An electronic oven of 700W was used. The results were shown in Table 1 described below.

Table 1

Kind of cooked food	Number of controlling openings	Heating time in electronic oven (seconds)	In receptacle		Blow-off time of steam (seconds)
			Temperature (°C)	Pressure (atm)	
Chicken nuggets	3	110	102	1.074	3
	3	115	103	1.109	8
	3	120	103	1.110	13
	2	110	Cracked at openings		1
	3	110	98	0.931	Very short
Green soybeans	6	95	98.5	0.948	Very short
	6	105	102	1.074	5
	6	110	103.5	1.126	10
	4	95	Cracked at openings		
Small size pork cutlets	3	85	99	0.965	Very short
	3	95	102	1.074	3
	3	105	103	1.109	13
Pilaff	4	120	98	0.931	Very short
	4	130	101	1.036	5
	4	140	103	1.109	15
Takoyaki (Octopus pudding)	5	95	99	0.965	Very short
	5	105	101	1.036	3
	5	115	103	1.109	13
Hot cake	5	40	98	1.036	3
	5	50	102	1.074	

Kind of cooked food	Judgement	Brief comment of taste estimation on food after cooked
Chicken nuggets	O	Good
		Feel watery
	X	Hard and inferior in feel to mouth
	X	
	X	Center portion was cold
Green soybeans	X	Center portion was cold
	O	Good
	X	Smell of scorching from outer surface
	X	Center of bean was cold
Small size pork cutlets	X	Center portion was lukewarm
	O	Good
		Moisture content of coating was insufficient
Pilaff	X	Some parts were cold
	O	Good, soft and full
		A part of rice grains was tough
Takoyaki (Octopus pudding)	X	Center portion was lukewarm
	O	Good
		Surface was dry
Hot cake	O	Good, soft and full
	O	Good, generally rather hard

In Table 1, hot cake was the chilled type, stored at +8°C, and the others were the cold type, stored at -20°C.

O : Good, : Fair, X : Poor

As can be seen from Table 1, the good cooked foods can be obtained when the foods are heated by the electronic oven at temperatures in the receptacles of at least 100°C, at pressures of 1.00 to 1.15 atm, for periods of 1.5 to 3 minutes. Particularly, it is undesirable to heat the food at a pressure of less than 1.0 atm, because the center portion of the food is insufficiently heated to be kept cold or lukewarm. When the pressure increases beyond 1.15 atm, the practical receptacle is cracked at the controlling opening. Further, in the bag-shaped receptacle, the seal portion is broken, and in the cup- or tray-shaped receptacle, the seal portion between the body and the upper lid is broken.

The receptacle constituted by a material able to resist a pressure of 1.15 atm undesirably results in the unbalance of evaporated moisture and the deterioration of the food compositions, particularly proteins, since the cooked foods adjusted in taste are packed in the receptacle.

Example 4

Embodiments of electronic oven cooking by using various kinds of receptacles will be shown hereinafter.

(1) An example of a bag

A bag 1 is sealed after food 3 is placed therein (Fig. 1(a)). The bag 1 is provided with steam controlling openings 2 depending upon the kinds of foods for cooking, considering the constituents of the foods such as moisture and oil. The steam controlling openings 2 are formed in such a manner that an internal pressure in the atmosphere of steam released from the food 3 packed in the bag 1 can be adjusted to the range of about 1.00 to 1.15 atm (100 to 105°C in temperature). To be concrete, usually the bag 1 is 350cc in inner volume and provided with 3 to 5 circular openings 2 each having a cross section of 1mm² Designated by 4 is a seal portion. The bag 1 containing the food 3 is placed in an electronic oven and heated. The bag 1 may be placed at any position in the electronic oven. The bag 1 is inflated (Fig. 1(b)) and the steam is allowed to blow off through the openings 2 by the electronic oven heating. When the heating is stopped after the steam is allowed to blow off through the openings 2 for a period of 5 to 10 seconds, the food becomes good for eating and the cooking is completed.

(2) An example of a cup

In the case of a cup, the principle is the same as in the case of the bag described above. A lid 6 of polystyrene is rigidly secured to the cup 5 at a seal portion 4. A limb 7 is formed at an outer peripheral portion of the lid 6. A steam controlling opening 2 is formed at a center of the lid 6.

Food 3 for cooking is placed in the cup 5 (Fig. 2(a)), and thereafter heated by the electronic oven. The lid 6 is inflated to a semispherical form by an internal pressure of the steam released from the food 3 (Fig. 2(b)), as well as the steam is allowed to blow off through the opening 2. On this occasion, the existence of the limb 7 shown in Fig. 3(a) make the inflation smooth. The heating is stopped after the elapse of a period of 5 to 10 seconds, and thereby the delicious cooked food good for eating can be obtained.

There may be used a double cup comprising on outer cup of formed polystyrene and an inner cup of a heat-resistant synthetic resin or paper for oil and moisture absorption, in consideration of hotness when the food in the cup is eaten, taking it by hand, immediately after cooked by the electronic oven heating. As shown in Fig. 3(b), there may further be employed a double cup comprising an inner cup 5' and an outer cup 5, wherein drips can be dropped in the clearance between the inner cup 5' and the outer cup 5 to removed when the lid is inflated to a semispherical form. Furthermore, though the cast is increased, a paper cup can be used as the inner cup, which has moisture-and oil-absorptive paper or thick nonwoven fabric sticked on the bottom portion thereof.

(3) An example of a tray

A similar lid 6 as that for the cup is adopted after food 3 for cooking is placed in a tray 8. A stream controlling opening 2 is formed at the center portion of the lid 6 (Fig. 4(a)). A cap 9 mounted at the center portion of the lid 6 is inflated by the steam generated from the packed food 3 (Fig. 4(b)), and the steam is allowed to blow off through the opening 2. Designated by 4 is a seal portion and designated by 7 is a limb. The heating is stopped after the elapse of a period of 5 to 10 seconds, and thereby the delicious cooked food good for eating can be obtained.

(4) An example of a bag including a tray

Food 3 contained in a tray 8 is placed in a similar bag 1 having openings 2 as described in the above paragraph (1) (Fig. 5(a)), and heated in the electronic oven, whereby a similar cooked food as described in the paragraph (1) can be obtained (Fig. 5(b)). This example is convenient for eating the food 3, since the food 3 is placed in the tray 8. Moisture-and oil-absorptive paper 10 may be mounted on the bottom of the tray 8, if necessary.

(5) An Example of a bag contained in a cup

A bag 1 containing food 3 for cooking described in the above paragraph (1) is placed in a cup 5, and the portion of the bag 1 protruding from the upper portion of the cup 5 is bent. Thereafter, the outer sealing package (not shown) is carried out (Fig. 6(a)). On the electric oven heating, the outer package is broken. The bent portion of the bag 1 is protruded out of the cup 5 (Fig. 6(b)) by the electronic oven heating, because the bag 1 is

inflated. It is preferable to use the single cup 5. Thus, the same result as described in the above paragraph (1) can be obtained and the food can be eaten immediately after cooked by the electron oven heating, taking it by hand.

As the embodiments described above, the cooking is completed after the steam is allowed to blow off through the controlling opening for a period of 5 to 10 seconds, and the inflation of the receptacle induced by internally pressurized steam can be visually observed.

Therefore,the completion of the cooking can be easily confirmed and the function as "watchman of electronic oven cooking" can be achieved.

To enhance the commercial value of the packed foods, the receptacle of the present invention can further be constituted as follows:

(1) With respect to the bag, it is preferable to use the above-mentioned particular three layer film comprising the inner layer of perforated polyethylene film, the intermediate layer of moisture-and oil-absorptive paper or nonwoven fabric and the outer layer of PET resin film, to absorb free moisture and oil released from the food. Particularly, in the case of a sponge cake which releases a small amount of free moisture and oil, the laminated film is designed by considering only heat resistance.

(2) With respect to the tray, free moisture and oil can be removed by using thick nonwoven fabric inside the tray.

(3) With respect to the cup, there can be used a double cup comprising an outer cup of foamed polystyrene and an inner cup of a heat-resistant synthetic resin, considering that the food in the cup is eaten immediately after cooked by the electronic oven heating, taking it by hand. The inner cup may be provided with a limb so as to absorb the drips of moisture and oil dropped from the deformed semispherical portion which acts as a watchman of the electronic oven cooking. Further, the paper cup can be used as the inner cup, which has moisture-and oil-absorptive nonwoven fabric sticked on the bottom portion thereof, thereby absorbing free moisture and oil.

Thus, the delicious cooked foods can be satisfactorily obtained from all the foods for electronic oven cooking of a chilled type on a cold type such as chicken nuggets, green soybeans, small size pork cutlets, pilaff, takoyaki (octpus pudding) and hot cake.

As described above, the present invention relates to the food receptacle for electronic oven cooking which comprises a steam controlling opening for allowing steam to blow off therethrough when an internal pressure in the receptacle is increased beyond a certain value by the steam generated on electronic oven heating of the food. The internal pressure in the receptacle can be adjusted to the range of about 1.00 to about 1.15 atm and the temperature in the receptacle can be adjusted to the range of about 100 to about 105°C. Further, the receptacle is inflatable by the increased internal pressure. The steam is allowed to blow off through the steam controlling opening for a period of not more than about 10 seconds, and thereafter the heating is stopped.

By these feature, the following advantages are obtained:

(1) On the electronic oven cooking, it is not necessary to defreeze the frozen foods. Particularly, in the receptacle constituted by the laminate of three layers, the balance between oil and moisture can be maintained and the cooking time is adjustable by the evaporated steam controlling opening according to the kinds of the foods. Further, the puncture of the receptacle can be avoided and the flavor of the food can be sufficiently maintained. Furthermore, since there is no leaking of oil or moisture from the receptacle after the electronic oven cooking, it can be held by hand without contaminating hand.

(2) All the foods for cooking which moisture contents are not more than 70% can be satisfactorily cooked by the electronic oven.

(3) Without being influenced by the types and the functions of the electronic ovens, the excellent food can be satisfactorily cooked.

(4) The functions of the electronic ovens can be fully exhibited and the foods can be cooked for a short period of time.

(5) The completion of the cooking can be observed by the inflation of the receptacle after the elapse of not more than 10 seconds, particularly 3 to 10 seconds.

Therefore, it is very convenient as the watchman of the electronic oven, and anybody can briefly cook the foods with ease.

(6) Further, there can be easily fabricated an apparatus which stops the heating of the electronic oven after the elapse of 3 to 10 seconds by detecting the steam allowed to blow off through the steam controlling opening formed on the receptacle. In addition to it, this operation can be associated with a buzzer, a color

lamp and the like. Accordingly, the electronic oven can be easily operated.

(7) The structure of the receptacle itself is extremely simple. Therefore, its manufacture and treatment are easy, inexpensive and economical.

(8) According to this receptacle, the circulation mechanism of the foods is improved from the circulation of the cold foods to that of the foods at ordinary temperature. For example, when the dry packing and the retort pouching are carried out by using a heat-resistant resin and the winding method in canning is substituted for the method in which the resin is pressed in contact, new commodities cookable by the electronic oven heating can be circulated at ordinary temperature, by being accompanied by lids provided with the steam controlling opening.

Claims

1. A food receptacle for electronic oven cooking which comprises at least one steam controlling opening for allowing steam to blow off therethrough when an internal pressure in the receptacle is increased beyond a certain value by the steam generated on electronic oven heating of the food.

2. A food receptacle for electronic oven cooking according to claim 1, wherein said receptacle is composed of a heat-resistant synthetic resin not permeable to oil and moisture.

3. A food receptacle for electronic oven cooking according to claim 1, wherein said steam controlling opening is formed in such a manner that an internal pressure in the receptacle is adjustable to the range of 1.00 to 1.15 atm and a temperature in the receptacle is adjustable to the range of 100 to 105°C, on the electronic oven heating of the food.

4. A food receptacle for electronic oven cooking which is inflatable with an increase of an internal pressure induced by steam generated therein on electronic oven heating of the food, and comprises at least one steam controlling opening for allowing steam to blow off therethrough when the internal pressure is increased beyond a certain value by the steam generated on the electronic oven heating of the food.

5. A food receptacle for electronic oven cooking according to claim 4, wherein said receptacle is composed of a heat-resistant synthetic resin not permeable to oil and moisture.

6. A food receptacle for electronic oven cooking according to claim 4, wherein said receptacle is prepared from a laminated sheet comprising an outer layer of a heat-resistant synthetic resin film not permeable to oil and moisture, an intermediate layer of one selected from paper and nonwoven fabric having oil and moisture absorptive properties, and an inner layer of a heat-resistant synthetic resin film having at least one small opening through which oil and moisture released from the food on the heating are allowed to pass outside by the capillary phenomenon.

7. A food receptacle for electronic oven cooking according to claim 4, wherein said receptacle is prepared from a laminated sheet comprising an outer layer of a heat-resistant synthetic resin film not permeable to oil and moisture, and an inner layer of nonwoven fabric having oil and moisture absorptive properties.

8. A method of electronic oven cooking which comprises using a food receptacle for electronic oven cooking, said receptacle having at least one steam controlling opening for allowing steam to blow off therethrough when an internal pressure in the receptacle is increased beyond a certain value by the steam generated on electronic oven heating of the food, and adjusting the internal pressure in said receptacle to the range of 1.00 to 1.15 atm and a temperature in said receptacle to the range of 100 to 105°C, thereby cooking the food for electronic oven cooking.

9. A method of electronic oven cooking according to claim 8, wherein the steam is allowed to blow off for a period of 1 to 10 seconds.

10. A method of electronic oven cooking which comprises using a food receptacle for electronic oven cooking, said receptacle being inflatable with an increase of an internal pressure induced by steam generated therein on electronic oven heating of the food and having at least one steam controlling opening for allowing the steam to blow off therethrough when the internal pressure in said receptacle is increased beyond a certain value by the steam generated on the electronic oven heating of the food, and allowing the steam to blow off through the steam controlling opening for a period 1 to 10 seconds, thereby cooking the food for electronic oven cooking.

11. A method of electronic oven cooking according to claim 10, wherein the internal pressure in the receptacle is adjusted to the range of 1.00 to to 1.15 atm.

Fig. 1

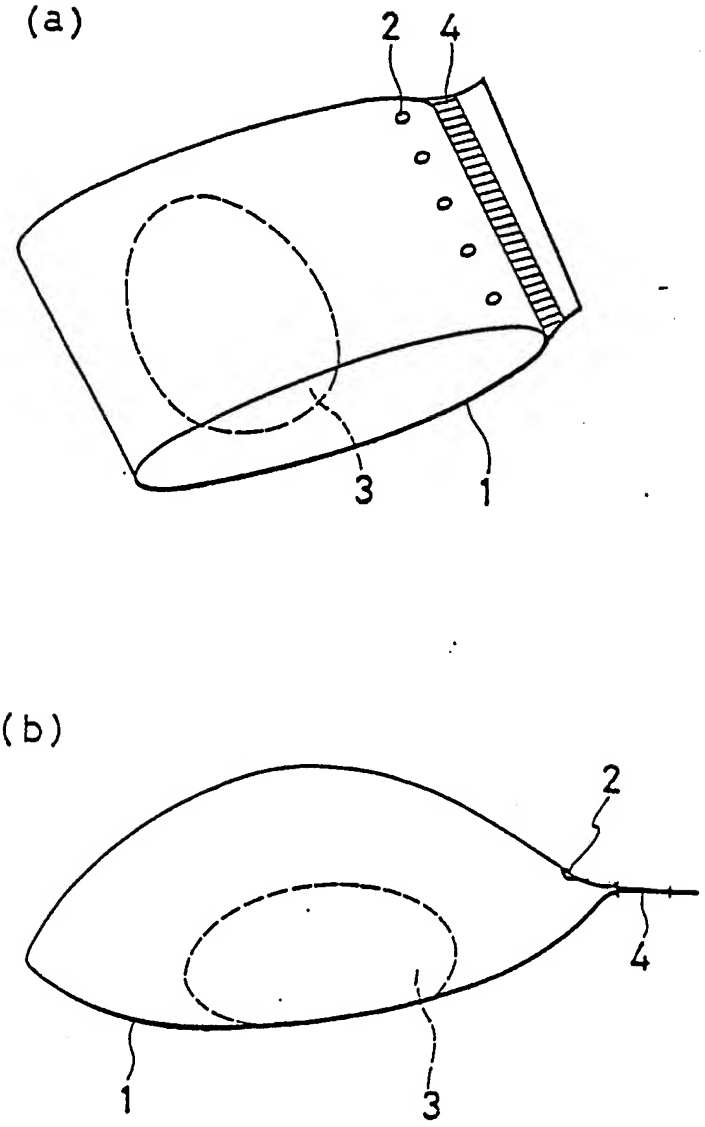


Fig. 2

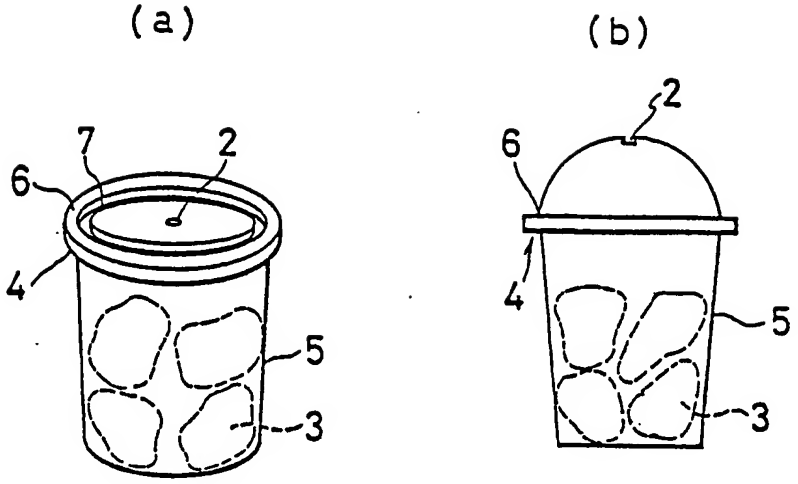


Fig. 3

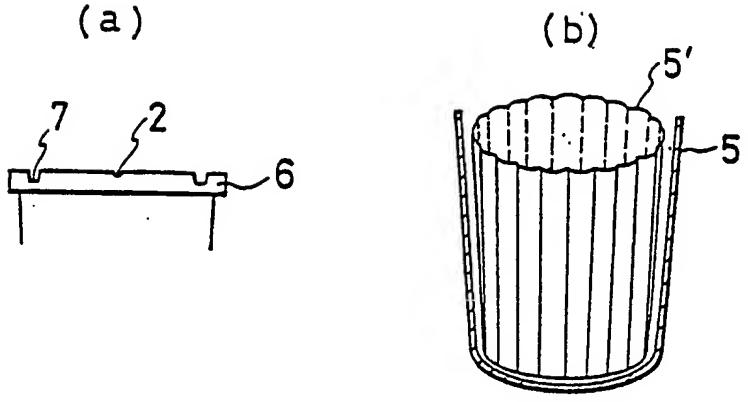
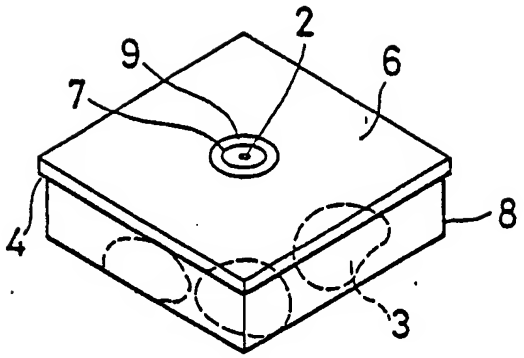


Fig. 4

(a)



(b)

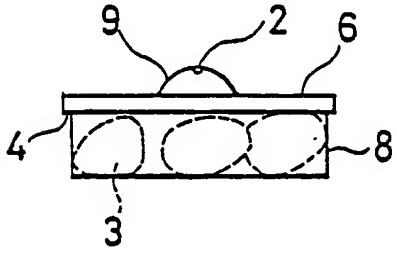


Fig. 5

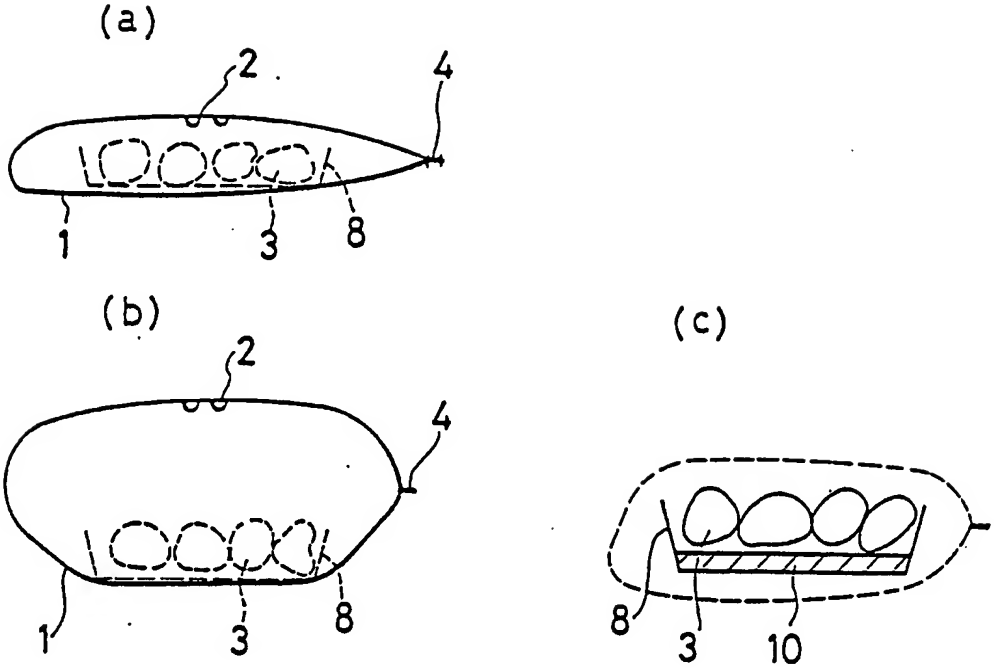


Fig. 6

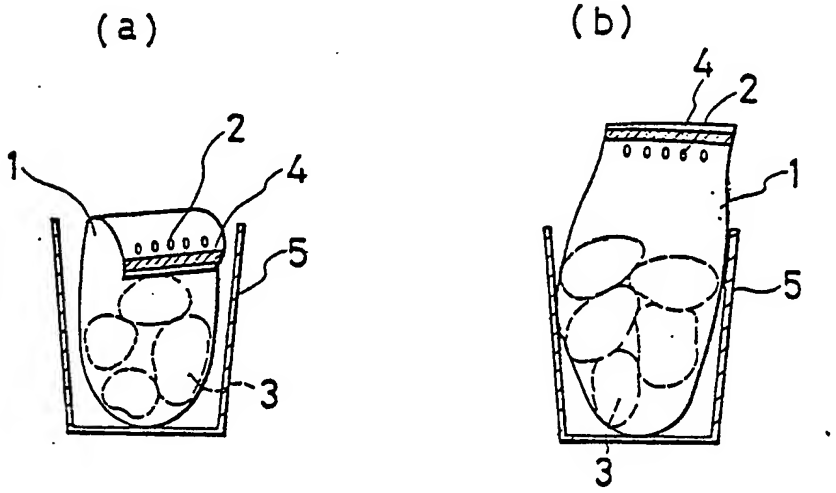


Fig. 7

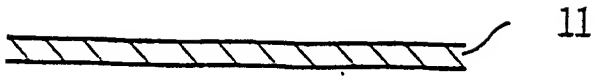


Fig. 8

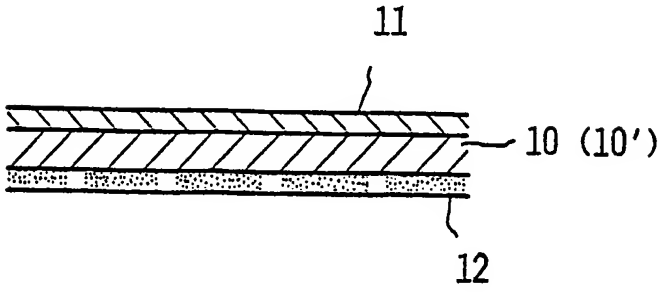


Fig. 9

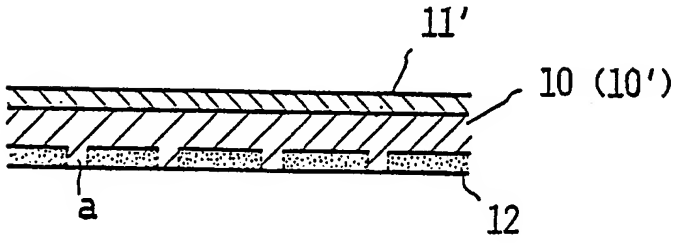


Fig. 10

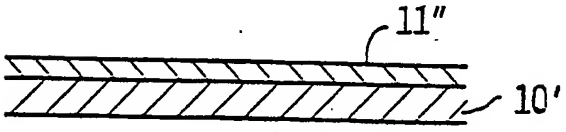


Fig. 11

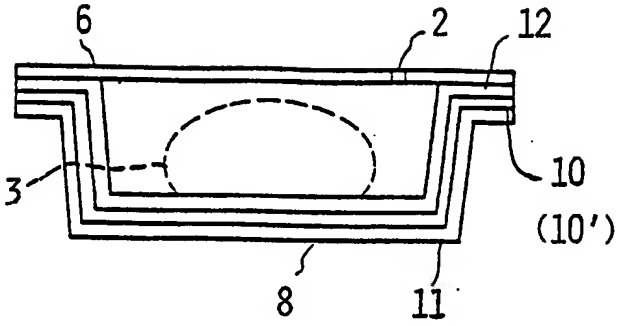


Fig. 12

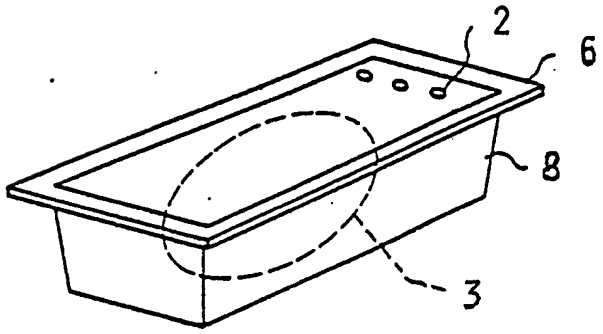


Fig. 13

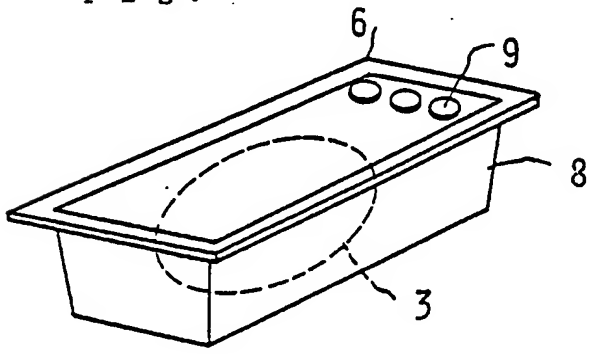


Fig. 14